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Test New Treatment To Protect Wood From Marine Borers.

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EVER SINCE man has been sailing the seas of the world in wooden vessels, shipworms and other borers have created problems. D'Anghiera, writing in 1516 of the return of Christopher Columbus to Jamaica during his fourth voyage, stated: "Their return to Jamaica, which is the island lying south and near to Cuba and Hispaniola was accomplished with great difficulty, for their ships had been so eaten by worms that they were like sieves and almost went to pieces during the voyage. The men saved themselves by working incessantly bailing out the water that rushed in through the great fissures in the ship's side and finally, exhausted by fatigue, they succeeded in reaching Jamaica. Their ships sank....".

This story has been repeated many times over and for hundreds of years men have been seeking methods to protect wood from marine borers. At the same time man has compounded the problem by distributing borers virtually throughout the world in the wooden bottoms of his ships.

Of course the problem is not confined to ships. Borers attack almost any wooden structure in the sea, including fishing equipment, piers, wharves, etc. Perhaps one of the most famous and serious situations to be caused by borers occurred in Holland about 1730. Much coastal land in Holland had been reclaimed from the sea and farms and even towns were below sea level and protected by dykes faced with wood. Prior to 1730 no trouble with borers had been encountered but from that time borer attack was so severe that dykes were destroyed and towns threatened.

Maritime marine wood borers

Borings in wood in sea water in the Maritime Provinces of Canada are caused by two different borers. These are the shipworm *(Teredo navalis)* which are often called "worms" and the gribble *(Limnoria lignorum)*.

Shipworms

Although they resemble "worms" in their elongated appearance, shipworms are really a type

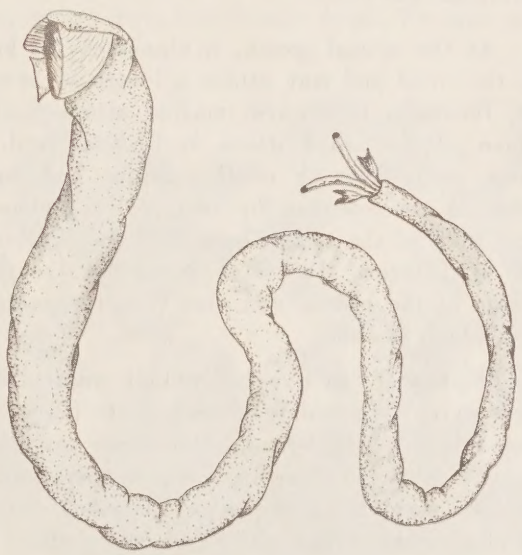

Fig. 1 – An adult shipworm removed from its burrow in the wood. One of the two shells is shown on the side of the larger end (about half life size).

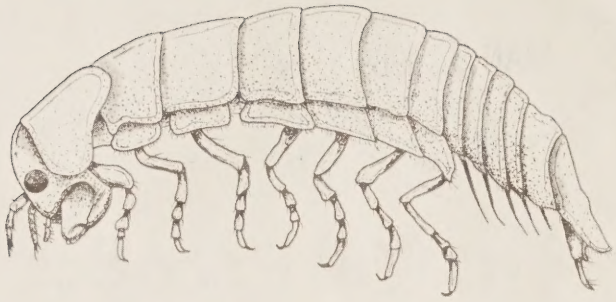

Fig. 2 – An adult gribble (much enlarged).

of clam or technically a bivalve mollusc. If a shipworm is carefully removed from its burrow in the wood, its two shells, which show that it is a clam, can be seen as small objects at the larger end. These altered shells have toothed edges and are used by the shipworm as jaws for boring through the wood. Figure 1 shows a shipworm that has been removed from its burrow.

In Malpeque Bay, P.E.I., where shipworms have been studied, they breed from June to September. Breeding occurs between water temperatures of 60 and 75°F and consequently in other locations the breeding season may be longer or shorter according to temperature. Young shipworms, released into the water as tiny larvae, swim for a short period before settling on wooden surfaces; there they bore in using their shells. Growth following settlement may be very rapid. In Malpeque Bay they are sexually mature in about 6 weeks and produce at least two generations per year.

As the animal grows, it elongates the burrow into the wood and may attain a length of over one foot. However, it always remains attached at the surface of the wood where it first entered. The burrow is lined with shell material and can be closed at the opening by two pallets, shown on either side of the tail, Figure 1. Food is obtained both by filtering the water drawn in through the opening of the burrow and also from the excavated wood, which is eaten.

Shipworms can live in brackish water and can even survive in completely fresh water for a period by closing off their burrow. Shipworms can survive long periods of near freezing water temperatures and can also survive air exposure for many days – in cool places where the wood does not dry out.

Gribbles

Unlike shipworms, gribbles belong to the group of animals technically known as crustacea, which also includes the well known shrimps, lobsters and crabs. Gribbles are smaller than shipworms, adults reaching only about 3/8th of an inch. Figure 2 shows an adult. Gribbles make much smaller burrows than shipworms, up to about 5/8 inch long; these excavations normally are confined to the surface 1/4 inch of the wood. Wood is eaten as food. In the Bay of Fundy, gribbles breed from July to December and further south do so all year round. The young are released in an advanced stage of development and are able to start burrowing immediately. Gribbles cannot survive where there is an appreciable amount of fresh water but will breed at lower temperatures than shipworms.

Differences in temperature and salinity requirements of the two borers result in differences in their distribution and abundance. Shipworms, although occurring almost throughout the Maritimes, are most common in warmer water areas, particularly the southern Gulf of St. Lawrence and the Bras d'Or Lakes. Gribbles are present throughout the Maritimes but appear to be more common in the cooler water areas such as the Bay of Fundy and the outer coast of Nova Scotia. Shipworms tend to be the major borers in river or estuarine areas, where fresh water occurs.

Damage caused by borers

Shipworms can do much more extensive damage to wood in a short period than can gribbles. This is because shipworm burrows are larger and extend deep into the wood, whereas gribbles remain at the surface, only gradually eating it away. Figure 3 shows an X-ray photograph of wood infested by shipworm. It shows the long holes made in the wood as well as the shells of the shipworms (appearing as black crescents in the picture). Wood heavily infested by shipworm is often completely destroyed in two months, nothing remaining but a mass of burrows. Figure 4 shows the damage produced to a piece of wood exposed to shipworm for two summer months at Bideford, P.E.I.

Where gribble infestation is heavy, the wood is gradually eaten away and softened at the surfaces, which then washes away. Several years are usually required for destruction of timber.

Past and present methods of wood treatment

The ravages by these borers and the cost and inconvenience produced by the damage has spurred the search for effective methods of wood treatment. This search has employed countless people and

encompassed several centuries.

The oldest method of protection was simply to dry wood in the hot sun at frequent intervals. Charring the surface of the wood was also an early method but it was not very effective. A coating of tar was also used very early. Some woods were found which resisted attack but none in ready supply. The only really effective method of protecting wooden ships from attack was to sheath the hull with a hard material such as copper plates or to cover the entire bottom with broad headed nails.

In more recent times several protective coatings and paints have been developed. Creosoting under pressure is perhaps the best of these because it penetrates deeply into the wood but it is generally only used on wood for fixed structures, such as wharves. Additionally, creosoting is fairly expensive and adds greatly to weight. Some marine borers in other areas attack creosoted wood.

Ordinary paints and other coatings do give effective protection as long as they remain intact. Special anti-fouling paints rely for their protective action on poisons, usually compounds of the metals copper or mercury, which are incorporated into them. These poisons gradually dissolve into the water and the paint has to be replaced at intervals.

Currently, a popular coating is ordinary netting tar, which is used on lobster traps. A more effective coating, consisting of a mixture of tar, copper oleate and kerosene, is also in limited use but for best results must be applied hot. Copper paint is almost universally used on boats but has disadvantages. It must be still wet when put in the water, it is fairly soft and has a short life, often necessitating re-coating in mid-summer.

All these methods, except pressure creosoting, have the disadvantage that damage to the coating will allow shipworms to enter and spread beneath the surface.

Experiments with a new treatment

Several years ago we learned of a new and promising treatment for wood which was claimed to stop marine borers. The treatment uses a new poison based on the metal tin, which is quite deadly or repellent to marine borers. The active ingredient is a chemical whose technical name is bis (tri-n-butyltin) oxide but which is usually referred to as TBTO. TBTO is a clear liquid which will not mix with water but mixes readily with mineral spirits (proprietory names Varsol, Irsol, etc.) or kerosene. The resultant mixture is thin and will readily penetrate deeply into dry wood. This chemical has the additional important advantage that is is strongly attracted to wood fibers and becomes firmly attached there. This means that TBTO becomes almost part of the wood and will only dissolve very slowly back into the water.

Experiments carried out at the Ellerslie Station over a three-year period tested varying concentrations of the chemical in several solvents on blocks of various woods as well as on boats, stakes, oyster trays and lobster traps. We have also

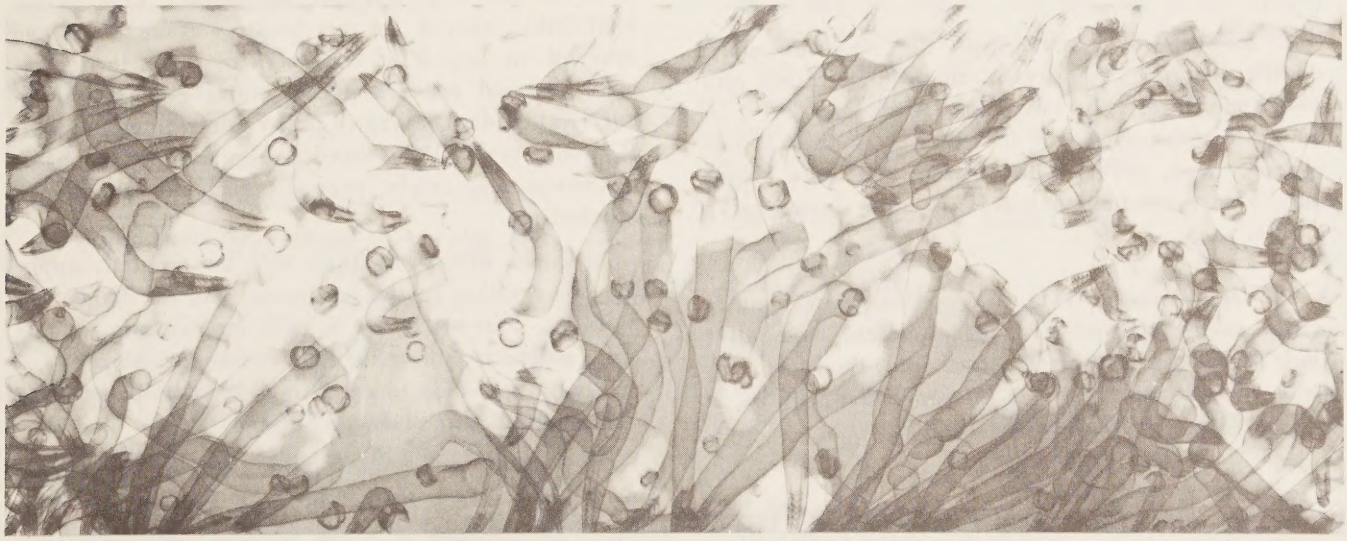

Fig. 3 – X-ray photograph of wood infested with shipworm. The shell material which lines the burrows can be clearly seen and the pairs of shells appear as dark crescents (Photograph reproduced by permission of D.B. Quayle).

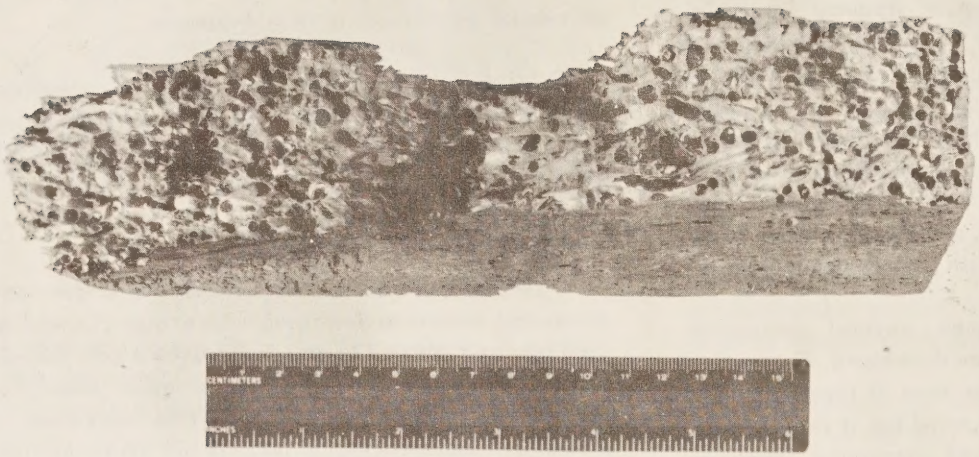

Fig. 4 – A piece of untreated spruce 2 x 4 exposed for two summer months at Ellerslie, P.E.I. The wood is a mass of burrows and crumbles readily. (Photo by P.W.G. McMullon).

checked for possible harmful effects on oysters and other useful animals.

Our tests have shown that a 2% solution of TBTO in mineral spirits or kerosene, brushed or applied by dip to dry or almost dry wood will give excellent protection against borers for at least two years. Penetration is sufficient to give moderate protection even where mechanical damage such as scuffing or scraping occurs.

Since success of this treatment depends on the TBTO combining with the wood, it is ineffective if applied over paint or on wet wood.

Its important advantages are ease of application, length of protection, ready penetration into wood and relatively low cost. Although TBTO is relatively expensive, the fact that it is used at low concentration, covers a large area, and lasts longer than former treatments makes it quite inexpensive to use.

Tests using TBTO on wood in close contact with oysters showed that the chemical does alter their normal growth pattern. It should, therefore, not be used on oyster trays or on wood that may be in contact with other edible shellfish.

New anti-fouling paints incorporating TBTO or related chemicals are now commercially available. Our test results with these paints show great promise and some important advantages over regular copper paint, the most important advantage of which is the production of a hard, smooth, durable surface which does not require frequent re-painting. Another property of special advantage to pleasure boat owners is that a wide range of bright colours is available.

Recommendations for the use of preservative solutions containing TBTO

The following methods are recommended where borers are a problem.

1. All new wood or wooden structures to be used in the sea (but not in contact with edible shellfish) should be at least surface dry, and brushed, or dipped for 2 minutes or more, in a commercial wood preservative containing 2% bis(tri-n-butyltin) oxide. Dipping is preferable where possible. If wood is to be worked (sawn or planed) after treatment, all newly exposed surfaces should be touched up.

2. On structures that will be painted, apply the preservative to the bare wood and let dry before painting. This will give a hull, for example, excellent protection even if the paint is chipped or scuffed. Apply only to bare wood. It will not penetrate paint, tar or other surface coatings.

3. For continuous protection of unpainted wood, the surface should be re-treated by brush or dip every two years.

4. Although the diluted chemical in the preservative solution you buy is not too poisonous,

take precautions with its use. Follow the directions on the can and DO NOT SPRAY.

Suitable preservatives

Although suitable preservative solutions and paints containing TBTO are being manufactured and sold, they may not be readily available in your area. It is expected that this situation will change as demand increases. Enquire at your paint dealer for wood preservatives containing TBTO or bis(tri-n-butyltin) oxide. Explain that you know they are available and ask him to contact his supplier about them.

A list of commercial wood preservatives containing TBTO is available on request, from the Fisheries Research Board of Canada, Biological Sub-Station, Ellerslie, P.E.I.

APPENDIX

Wood Preservatives Containing TBTO

Suitable preservatives being made are as follows:–

(1) Pettit #2030 Clear Preservative. (#2050 – 1%)

Manufacturer. Pettit Paint Co., Inc.
507 Main Street,
Belleville, N.J.
U.S.A. 07109.

Canadian Distributor: Brydon Brass Mfg. Co. Ltd.
Brydon Drive and Rexdale Blvd.
Rexdale, Ontario.

(2) Dolphin #9150 Wormicide.

Manufacturer. Dolphin Paint and Chemical Co.,
922 Locust Street,
Toledo, Ohio,
U.S.A. 43603.

(3) Balto-Tin #3811 Preservative.

Manufacturer. Baltimore Copper Paint Co.,
501 Key Highway,
Baltimore, Maryland,
U.S.A. 21230.

(4) U.S. Yacht #905 Wood Preservative.

Manufacturer. U.S. Yacht Paint Co.,
Roseland,
New Jersey, U.S.A. 07068.

Canadian Distributor: Aqua Marine Mfg. Ltd.,
36 Vine Avenue,
Toronto, Ontario.

Two other preservatives containing the chemical but also an insecticide for more effective gribble control are listed below. This **must not be used on lobster traps as the insecticide may kill lobsters.**

(1) Nautox

Manufacturer. Osmose Wood Preserving Co. of America,
980 Ellicott Street,
Buffalo, New York,
U.S.A. 14209.

(2) Pentox X2205.

Manufacturer. Osmose Wood Preserving Co. of Canada,
Pratt Avenue,
Montreal 8, Quebec.

Enquiries about any of the above preservatives can be directed to the addresses above, or enquire about these products at your local paint, marine or hardware store. Note that the chemical may be referred to by trade name on these products. Look for the bioMet TBTO content. This is the registered trademark for bis(tri-n-butyltin) oxide made by Metal and Thermit Chemicals Inc. There may be suitable preservatives using chemical made by other companies available but if so we are not aware of them.

Large quantity users may wish to make up their own preservative by mixing 2% bis(tri-n-butyltin) oxide in mineral spirits. However, we do not recommend this for the small user owing to the toxicity of the raw material. If the preservative is mixed, protective clothing must be worn and precautions against accidental poisoning taken. The following companies manufacture the chemical:

(1) Metal and Thermit Chemicals Inc.,
Marine Division,
100 Park Avenue,
New York 17, New York,
U.S.A.

Canadian Distributor: M and T Products of Canada,
Box 211 Station C,
Hamilton, Ontario.

(2) Advance Division,
Carlisle Chemical Works Inc.,
New Brunswick,
New Jersey, U.S.A. 08903.

Canadian Distributor: Advance Solvents of
Canada, Ltd.,
785 Plymouth Avenue,
Town of Mount Royal,
Montreal, Quebec.

(3) Stecker Chemicals Inc.,
50 North Franklin Turnpike,
Ho-Ho-Kus,
New Jersey, U.S.A. 07423.

Details could be obtained from the above addresses.

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TBTO – A Safe, Effective Treatment for Lobster Traps

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The Canadian lobster fishing seasons are so regulated that in most areas lobsters are fished during the cooler months when damage from shipworms is not a serious problem. In the northern half of Northumberland Strait, however, the lobster fishing season is from August 10 to October 10. During this warm water period, shipworms may cause extensive damage to lobster traps. To avoid such damage, many fishermen in this area dip their traps in hot or cold tar shortly before the season opens. This reasonably effective but rather unpleasant treatment is reported to cost about 15 cents per trap. Some fishermen claim that freshly tarred traps catch fewer lobsters.

To evaluate the TBTO treatment for lobster traps, 20 new traps were dipped for 2 minutes in a 0.5% mixture of TBTO in varsol. About 2 gallons of the mixture were used up at a cost of roughly 7.5 cents per trap for materials. The treated traps and 20 untreated but otherwise identical traps were fished together off Miminegash, P.E.I., throughout the August 10 to October 10, 1964, season. There was no appreciable difference in the catch of lobsters from the treated and untreated traps.

Too few shipworms settled during the 1964 season to enable us to judge the effect of the treatment. We therefore fished the same traps without further treatment throughout the 1965 season. At the end of the season, the untreated traps averaged 33 worm holes per lath, the treated traps only 2 – a reduction of 94%.

NO DAMAGE TO LOBSTERS

Further tests were carried out to determine whether lobsters caught in treated traps would pick up harmful amounts of poisonous TBTO. Lobsters were put in TBTO-treated traps that were then held for 1 to 4 days in tanks supplied with running sea water. Under these severe test conditions many of the lobsters weakened and died. However, when lobsters in treated traps were held in the sea for 2 days under actual fishing conditions, they showed no ill effects over a 3-week period. If TBTO is used according to instructions, lobster traps can be treated with little risk of damage to the lobsters. It is not recommended for the treatment of lobster cars or tanks where the water circulation is so reduced that lobsters could be exposed to harmful concentrations of TBTO for extended periods.

If the lobster traps are dry when treated and fished only 2 months each year, a 0.5% mixture of TBTO gives good protection from shipworms at low cost and with little risk of injuring the lobsters. For the treatment of wet traps, those made of green wood or those fished for longer periods, a 1% mixture of TBTO is recommended.